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REVISED OUTLINE FOR SCIENCE 30 (Chemistry) 1954-55

For the school year commencing September 1954 there will be further modifications in the Science 30 course. The course will be as follows:

Authorized Text: Jaffe: *New World of Chemistry.* (Referred to in this outline as the "Text".)

Experimental Work in Chemistry—*Bulletin 5b* (Department of Education—25c) (Referred to in this outline as *Bulletin 5b*).

Reference Text: Croal, Couke, Louden: *Chemistry for Secondary Schools.* (Referred to in this outline as Ref. Text CC & L).

Revised Outline: In the logical development of the theory of chemistry as treated in this course each chapter or group of chapters from the Text deals with something specific to the pyramid of information and concepts. In order to suggest the particular purposes for including various chapters, the outline is divided into sections, for each of which a theme is indicated.

In addition to the required experimental work from *Bulletin 5b* three experiments (indicated as "A", "B" and "C") have been added to this outline. The purpose of these is twofold—(1) to illustrate a theory, law, etc. as the case may be, and (2) to introduce the student to certain laboratory techniques, such as the use of the balance, measurement of volumes, working with the metric system of measurement, etc.

All pages from the Text refer to the 1952 edition of Jaffe, while pages in the Ref. Text CC & L also refer to a 1952 edition. Pages from *Bulletin 5b* are from the 1949 edition. In the experimental work the numbered experiments are from *Bulletin 5b* (Note that Nos. 10, 11, 12, and 13 *are omitted*) while the lettered experiments refer to the additional required work in this outline.

It is suggested that the experimental work be conducted at the same time that the chapter is being studied.

Section 1: Chapters 6, 8, 9, and pages 668 (More Calculations) to 673 (end of Practice Work on Problems of Type 5B), Text.

Suggested Time: 4 weeks.

Theme: Chemistry has its own particular language; the written expression is accomplished by a form of "shorthand" (Ch.6). The chemist experiments, and uses this "shorthand" to describe the results in the form of an equation (Ch.8). General reactions however are not enough, and the chemist must be able to indicate specific amounts of material which, when they react chemically, will produce definite yields (Ch.9).

Practical and Experimental Work:

Experiment "A"—A demonstration of the law of conservation of matter should be carried out. This is illustrated and described on page 118 of the Text.

Experiment "B"—Quantitative techniques as well as the mathematics of chemical formulas can be illustrated by the determination of the water of crystallization of crystallized copper sulfate. This is carried out by heating a known weight of crystallized copper sulfate in a crucible until all the water is driven off. The dried copper sulfate is then weighed and the calculations completed in the same way as illustrated in problem number 8, pp 132-133 of the Text.

Useful Ideas Developed: Chapter 6, pp 93-94
Chapter 8, p 121
Chapter 9, p 133

Section 2: Chapter 10.

Suggested Time: 2 weeks.

Theme: The Halogens illustrate that elements may be grouped according to properties they possess in common. See the paragraph, page 142, entitled "An Element is Known by the Company it Keeps".

Practical and Experimental Work:

Experiment 1, *Bulletin 5b*, page 36.

Useful Ideas Developed: Chapter 10—page 150

Section 3: Chapter 19 and pages 673 (How the Molecular Weight of a Compound is Determined Experimentally) to 677. (End of example of laws of Boyle and Charles combined).

Suggested Time: 2 weeks.

Theme: In this chapter it is shown that volumes of gaseous compounds enter into chemical reactions in very simple ratios such as 1:1, 1:2, 1:3, 2:3, etc. The volume ratios are compared after the volumes have been reduced to standard temperature and pressure (S.T.P.—zero degrees Centrigrade and 760 mm Hg). This requires a working knowledge of Boyle's and Charles' laws.

Avogadro's hypothesis is used to account for these simple ratios; and also to define the molecular weights of these gaseous compounds. An important application is the prediction of the volume of the gas produced in a chemical reaction.

Practical and Experimental Work:

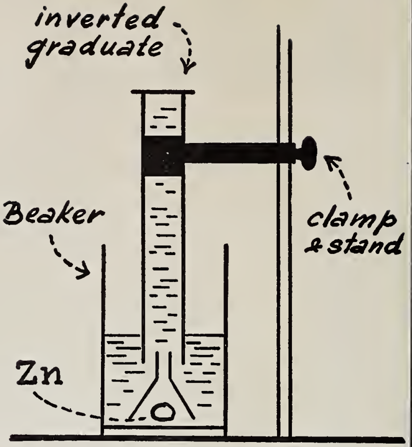
Experiment "C"—An experiment to demonstrate that we can actually predict the volume of a gas that will be produced during a chemical reaction. (To be demonstrated by the teacher, or where possible carried out by the class.)

Apparatus: 1. a one liter beaker 2. a small funnel (1½" in diameter and stem cut to ½") 3. a 100 ml graduated cylinder 4. clamp and stand 5. a balance capable of weighing to 1/100th of a gram 6. a barometer 7. a centigrade thermometer.

Materials: 1. dilute sulfuric acid 2. Mossy zinc. NOTE: If C.P. or reagent zinc is used it will be necessary to add a small amount of copper sulfate solution which will act as a catalyst.

Procedure:

1. Weigh the zinc to the second decimal place, keeping the limits between 0.15 grams and 0.20 grams.
2. Place the zinc in the bottom of the beaker and cover it with the inverted funnel.
3. Fill the graduated cylinder with water, and covering it with the palm of the hand, invert it into the beaker, lowering the open end over the funnel.
4. Pour off as much water as possible without allowing the air to enter the cylinder.



5. Clamp the cylinder in position and add the sulfuric acid until there is a steady evolution of gas into the cylinder.
6. After the metal has completely reacted, adjust the liquid level by adding water so that the level inside the cylinder is the same as the level in the beaker. (In this way we have adjusted the volume of the gas in the cylinder to atmospheric pressure.)
7. Note the volume of the gas in the cylinder.
8. Noting the temperature and barometric pressure compute the volume noted in (7) above to a volume at S.T.P.
9. Compare the actual results with the theoretical results.

EXAMPLE:

When this experiment was conducted in one laboratory, the following results were obtained:

Weight of Zn used—0.20 grams

Pressure —70 cm

Temperature —27 degrees C.

Volume of gas delivered—85.2 ml.

Adjusting for temperature and pressure:

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$$85.2 \times \frac{273}{300} \times \frac{70}{76} = 71.3 \text{ ml at S.T.P.}$$

Theoretical yield:

$$Zn + H_2SO_4 \rightarrow H_2 + ZnSO_4$$

$$\frac{.20 \text{ gms}}{65.38} = \frac{x \text{ ml}}{22{,}400 \text{ ml}}$$

$$x = 68.6 \text{ ml at S.T.P.}$$

The fact that the actual yield is higher than the theoretical yield is due to the presence of water vapor in the hydrogen.

Useful Ideas Developed—

Chapter 19, page 292, the Text.

Questions for practice, section "b", page 99, and section 2, page 152, Ref. text C.C. & L.

Section 4: Chapters 11, 13, 14 and 16.

Suggested Time: 7 weeks.

Theme: The electron theory is a fundamental and major concept of matter (Ch. 11). This is illustrated by reference to two special classes of matter—acids and bases (Chs. 13 and 14). "Ionization" refers to the electron theory in action (Ch. 16).

Practical and Experimental Work: Nos. 2, 3, 4, 5, 6, in *Bulletin 5b* pp 37-42.

Useful Ideas Developed: Ch. 11, p 174, text.

Ch. 13, p 210, text.

Ch. 14, p 220, text.

Ch. 16, pp 254-255, text.

Section 5: Chapters 25, 26, 27 and 28.

Suggested Time: 8 weeks.

Theme: Metals have certain characteristic chemical properties in common (Ch.25). Because of the particular characteristics of certain metals, three chief metallurgical processes have been developed:

Electrolysis—(aluminum, Ch.26)

Reduction by carbon—(Iron, Ch.27)

Roasting—(Copper, Ch.28).

Practical and Experimental Work: Nos. 7, 8, and 9, *Bulletin 5b,* pages 42 to 45.

Useful Ideas Developed: Chapter 25, pages 397-398, Chapter 26, page 418, Chapters 27 and 28, no summary given.

Section 6: Chapters 34, 35 and Chapter 36 as far as page 612.

Suggested Time: 7 weeks.

Theme: This is an introduction to organic chemistry, "the chemistry of the compounds of carbon". The unique property of carbon enables its atoms to unite chemically to produce different compounds, (Chapter 34.). The compounds may be grouped into classes, some of which are discussed (Ch.35). The relationship of carbon compounds to diet is treated (Ch.36 as indicated).

Practical and Experimental Work: Experiment No. 14 (careful supervision is suggested) Nos. 15, 16, 17, *Bulletin 5b,* pages 49 to 52.

Section 7: *Bulletin 5b,* pages 52, 53, 54, "Examination of acid radical" and "Scheme of Identification of Certain Cations".

Suggested Time: 2 weeks.

Theme: This involves elementary qualitative analysis for selected anions and cations. An important concept is that the use of a selected reagent produces a specific result. While the main part of this section is practical work, the teacher should be sure that the students understand the basic theory behind the various tests.

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